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The Effects of Exhaustive Military Activities in Man. The Performance of Small Isolated Military Units in Extreme Environmental Conditions

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About the author Surgeon Captain L. Vanggaard served as a young military doctor with the Danish Army ranger unit. After joining the Royal Danish Navy he was involved in the medical training of the Danish Navy's frogmen. He has been involved with the SIRIUS patrol in North-eastern Greenland as medical adviser since 1968. As a senior lecturer he taught physiology at the Universiq of Copenhagen. Scientific work has centred on human thermoregulation with special interest in circulatory function in the extremities and its role in the development and treatment of hypothermia and local cold injuries. At present he is head of the Naval Medical Service. Danish delegate to DRG / PANEL 8. Editor of the NATO Handbook on Military Clothing. Editor of the NATO Handbook on the Handling of Casualties in Extreme Cold. Author of the Danish Ship Captain's Guide. Chairman of the COMEDS WG on Medical Training.

MAN IN ISOLATED AREAS

ABSTRACT

Denmark has since 1951 operated its dog-sledge patrol SIRIUS along the North-eastern shores of Greenland. On each patrol 2 men and 10 dogs covers between 3000 to 4000 km. In this service they may not have any encounter with other humans for a period of 4-5 months. For this duty predeployment screening, selection, and training is of outmost importance. The decisive factor in succeeding in this military task is that each man gain confidence in himself and his colleagues. The role of experience is vast, but as each man is only assigned to this duty for 2 consecutive years it means that the "memory" knowledge stored within the members of the SIRIUS patrol only amounts to two years. Each individual thus has to master all the details of Arctic life necessary to live and accomplish his tasks. One of the operational principles is to regard the service in the patrol not as one of survival, but one of doing a regular job. The term survival technique is only attributed to those situations, where life is really at stake.

The aim of this article is to focus on selection criteria for duty in isolated areas, on factors relevant for such a duty, the importance and content of training, the role and duties of the back-up organisation, and finally how this is accomplished in the operations of the Danish dog-sledge patrol in the Northernmost Arctic.

Operating small isolated military units especially under extreme climatic conditions present a series of problems. Most nations do have such units dedicated to these tasks. The problems will change from mission to mission, but there are certain general aspects. One way to define these is to look at specific groups and from these try to come to a conclusion and determination of the common problems. Many of these may present themselves as very different, but analysed it may turn out, that the difference between operating in the cold of the high Arctic or the heat of the desert may less than expected. In Denmark the service of the Danish Sledge Patrol SIRES in the isolated parts of Northern Greenland may serve as the model for describing the problems in operating isolated military units.

Paper presented at the RTO HFM Workshop on "The Effect of Prolonged Military Activities in Man. Physiological and Biochemical Changes. Possible Means of Rapid Recuperation", held in Oslo, Norway, 3-5 April 1995, and published in RTO MP-042.

BACKGROUND

The Danish dog-sledge patrol SIRIUS was founded in 1951 as a Naval Force in the time of the Cold War. It had its predecessor in the sledge patrol formed during WW II in cooperation Beethoven the Danish Government in Greenland and the U.S. Coast Guard. This earlier patrol consisted of fur-trappers isolated in North Eastern Greenland. During the war, the sledge patrol located and destroyed several German weather bases along the coast. The weather of Greenland being the cradle for the meteorological conditions of the North Atlantic and Northern Europe. It has been stated, that it was weather reports from Greenland that made General Eisenhower decide to go on with OPERATION TORCH, the landings in Normandy in 1944 in spite of the local bad weather. The role of the sledge patrol was and still is to exercise the Danish / Greenlandic souverainity in this otherwise completely uninhabited part of Greenland, stretching from 70°N to 81°N. The patrolling is carried out in summer by airplane and boats (in the southern parts), but the main task is to patrol the coastline and its deep fjords by dogsledges. The patrolled coastline thus expands to about 40.000 km. The weather during winter is a harsh Arctic climate with frequent storms up to around 60 knots, blowing snow, and air temperatures down to - 50°C. Each dog team consists of 2 men and 10 dogs, using a travelling technique that has been adopted but modified from the original Eskimo dog sledge technique. In summertime depots of provisions and necessary reserve equipment have been placed along the coast by air or by boat as far north as the ice permits. In the area smaller huts have been erected not so much for the benefice of the men, but to protect the depots from the frequent visits by the polar bears, who does not recognise and respect the logo of the Danish Government.

THE JOB

The SIRIUS patrol consist of volunteers that has signed for this service for a period of 2 years. Before their deployment to Greenland they are trained for a period of 6 months in those skills and techniques that can be taught in Denmark (elementary ski-training is carried out in Norway with the Norwegian Forces). When arriving in Greenland they are assigned to a specific dog-team, and they will for the next two years always identify themselves with that dog team and its 10-12 individual dogs. The relation man / dog is one of the most important factors in their duty. This relationship will develop into a nearly personal relationship. Each team will feed its own dogs, take care of them and thus develop a "friendship" that will carry them together through the long journeys of the winter. Each individual dog-sledge team will consist of an "old hand" who is the leader and a newcomer. The old man is not only the leader, he is before anything else the trainer. Next year he will leave all the responsibilities to the new "old man". This principle of apprenticeship is a tradition in Greenland, and it is the basis for the operations of the patrol. At any time traditions and knowledge and memory is only as old as the oldest man in the patrol. To ensure the continuation of operations a former patrol-man is in charge of the administration and command of the patrol from his desk in the Danish Naval Command in Denmark. Operational control is exercised by the Island Commander Greenland (ISCOM GREENLAND) in Southern Greenland, but all provisions and logistics are provided from Denmark.

THE WINTER JOURNEYS

The winter journeys are the main objective of the SIRIUS patrol. Each team will have a route of between 3-4.000 km to cover. Dog sledging is hard work. The sledge has to be pushed, dragged, lifted, kicked forward sometimes on smooth fjord ice, where occasionally men and dogs feel like flying along, and at other times through loose deep snow, where every meter is a hard won victory, where the daily distance covered may be down to 4-5 km, and where distant mountains seem unchanged in appearance and distance for days. The daily accomplishment for a team is its covered distance, the reward is the tent, a pipe (if so inclined), and to relax with a hot meal - radio communication with main base - and sleep. Temperatures are far below zero. High wind may be prevailing. Wind-chill index is only a theoretical consideration without any practical relevance. You must learn to live in the nature as it present itself, as the Arctic animals, dependant completely on yourself and your techniques. Not surviving, but cunning is the principle. The margin between success and failure, between life and death may be narrow, but not narrower than you always have time to think and analyse - but in many cases not to err. Everybody realises, that he has only himself and his buddy to depend upon. Nobody can bring in any help within days. If the team drives through the ice, they are faced with a hard

job to free themselves, get out of the water, continue to a safe place where they with icing in the clothing, frozen fingers must untie the tent, rise it and lit the stove to dry out the wet clothing and material. This may take place at the height of the winter, where the sun has not been over the horizon for weeks, and where the only light is from the stars and the moon - if present. In the northern parts of the area it stays under the horizon like the sun and does not rise for a week or more.

The daily routine during the sledge voyages follows a fixed pattern, each sledge team make s its own adjustments, but these are seldom changed when first established. The ringing of the alarm clock wakes the one responsible for lighting the stove for melting snow. Breakfast consisting normally of oat meal with milk and tea or coffee. Melting of extra water for filling the thermos bottles with fluid for the whole day. Then breaking camp. Loading the sledge (each sledge carries around 400 kg of equipment, inclusive of extra (emergency) rations for men and dogs for 10 days). During the travel stops are made when necessary, either for rest or for fighting or rearranging the dogs who have their own appreciation of how and with whom they want to spend their day. During the day small meals will be taken, often consisting of raisins, chocolate etc. When the goal has been reached, the dogs are freed from their harnesses and for a short time are allowed to wander freely about - they know they will not be fed before they are back at their specific place in the chain. The tent is risen, snow is melted for the daily heavy meal. Radio communication with base is established, but not many unnecessary words are spoken, batteries should last the whole journey, and everybody knows that to o long correspondence s may mean , that power for transmission has to been produced by cranking the dynamo, which is no fun. This is the time for talk, at an outdoor temperature of -45° it is difficult to talk Sleep comes quickly. Personal hygiene is carried out in the evening. It hurts to meet the cold with fresh washed skin.

The darkness of the Arctic winter is often represented as a period, where man becomes depressed and moody. This can only be overcome by demanding work and routines, never slackness where the individual may "sink into himself'. On the sledge journeys the hard work is the medicine, at base winter time is the time, where preparations for the next journey takes place. Each team is responsible for its sledge and its dogs. Each team makes its own sledge from the raw materials. They must know every part of it and be able to repair any damage. The sledges themselves is the pride of its team. The basic construction is standard to facilitate the use of spare parts left in the depots along the route, but each team will find some way or other to distinguish their "ship". Discussions on sledge construction and sledging practices are always sure to bring everybody together.

Discussions are a measure of the psychological temperature of a group. This so much more in the small isolated group. It is typical of the small group, that discussion may be agitated. Everybody knows the other person so well, that his way of arguing, and his attitudes can be foreseen - if he not for the sake of the argument - chooses to take the opposite point of view. From an outstander the argument may be heated, and he may feel uneasy about the vigour and the hard points made - but in a well functioning group - and basically I know not of others in the Arctic - there are certain rules which nearly always are obeyed. Even the most frightful discussion may suddenly stop, everybody calms down and a cup of coffee or tea is produced - everything forgotten. This is the sign of the well-functioning group. Everybody knows the other, he may even dislike him or be opposed to him, but the society is too small, the group - and the individual - has to live together also tomorrow and the next day, week, month, perhaps year. When your whole company may be smaller than ten persons you cannot afford to loose any of them. As an old hand on a weather station at one of my first visits to the Arctic once answered when I asked him if he did not at times feel lonesome: "See Doc, here I know 7 other persons, I know, really know everything about them, and they me just as well - how many do you know, I mean, really know" - I was abashed and had learnt one of my first lessons of life in the Arctic.

Within the s ledge- team, where two men has to work closely together, share the same experiences, when not working living in a tent 2 times 3 meter. To be completely dependant upon each other and not having the possibilities of speaking to anybody else is a heavy demand on a person in his twenties. There may be periods, even days, where the communication may be non-verbal, where only the most necessary words are exchanged. This may not be a negative sign, but rather a sign of the complete awareness and knowledge of the other. The talkative person has a long and perhaps not too pleasant way to go before he learns that much can be said without words.

To the Arctic mammal living is not survival. It has been said about the Arctic peoples the Eskimos, that their culture was a culture of survival. But no culture can live on the brink of survival for any extended period. A culture must exhibit a surplus to exist. Nobody can live and prosper on survival terms. One of the secrets of living in any isolated and harsh environment is to make the daily life a well established routine. It has to be based upon fixed and well established procedures. Expedition life is often described as a kind of scouting, where the success depends upon improvisations and will to overcome deprivations. This is the unprofessional way of the small group. If one wishes to succeed in and accomplish the task given one of the most important principles is to "be prepared", not as a boy scout for everything, but for any conceivable contingency that may arise. To be a member of the sledge patrol it is necessary to be well trained for this particular work. But like any other military task it is just a job perhaps unlike any other, but it is the job you are trained to do.

The principle behind the way the Danish sledge patrol rests on well established procedures. The individual is trained theoretically and during his first year "on the job" in living as a "mammal" in its environment. He should have full protection from his clothes, and his equipment is designed for the task. In the Arctic the most dominant feature is the cold. But if the energy balance of a sledge team on journey is made up, the only real heat input is that provided by the food and the fuel used is mainly to melt the necessary snow to cover the unavoidable water loss.

Water is one of the main enemies of the Arctic traveller. Water in excess of what is needed for consumption is threatening man's well-being and perhaps even his existence. Water, frozen to ice will destroy the insulation of his clothes, his sleeping bag. It will accumulate and make the equipment heavier day by day. In certain military exercises water accumulation has been measured amounting to more than one litre per day per person.

The water removal from clothing and equipment is managed by the tent system. As mentioned the tent is not heated. It consists of a single layer of cotton. It is shaped like half a barrel as this shape has been found to be best in avoiding drifting snow to cover the tent. A tent like this could not tolerate rain, but its permeability, where the dry Arctic air is allowed to penetrate dries out the clothing during the night. The increase in weight of the equipment (clothing, sleeping bag etc.) amount to a few kilograms during a sledge journey of 3-4 months.

All equipment has to function after four months of heavy duty as well as on the first day or night. This leads to the preparations necessary for any longer isolated stay. All equipment must be thoroughly well prepared and tested. Even with the rightly chosen personnel any mission may have to be aborted due to faulty materials. Confidence in and knowledge of your equipment, its functions and limitations is of paramount importance. Amundsen knew this when he dashed to the South Pole in 1911, Scott the brilliant and courageous amateur succumbed. Preparedness is not only a state of mind it is as well a logistic and engineering hard accomplished condition. Too many parties (military, sportive or scientific) has endured unreasonable hardships if not complete failure due to foreseeable but not met requirements.

Food is one of the soldier's best rewards. This has always be recognised by the military leaders. Bad or lacking food has been the cause of most mutinies in the navies. The military history is full of examples of the deleterious effect of faulty supplies. The provision of good and plenty food is one of the most important parts of the planning for any isolated group that has to carry out a task in an isolated environment. It should be recognised that every individual has his favourite tastes. These can of course not all be met, but the food should be thus composed that it gives amble possibilities for individual variation. A package of different spices may be the factor that changes that for caloric reasons necessary pemmican into a endurable and even palatable and varied meal. Food is not only calories (joules or whatever). For a person that endures fatigue, cold, uncertainty, fright or perhaps even pain food is the daily reward. It should be sufficient in energy content and at the same time varied. Whenever possible the men should themselves be encouraged to participate in the selection of their food under the supervision of someone who can make the necessary corrections to ensure its sufficiency.

The recommended composition of U.S. military food is a caloric distribution of: 60-65% as Carbohydrates, 12-15 as proteins and 20-25 % as fat (+ vitamins, minerals etc.)

The caloric distribution in the Danish rations for the sledge patrol is: carbohydrates 17%, protein 28% and fat 55%. This is the basic composition when operating at temperatures around -40 to -50° C. At higher temperatures the fat content is diminished and replaced by carbohydrates.

In the cold experience has shown that the body besides an increased caloric input demands a very high fat intake (2). Some may speak of a craving for fat. Butter and ingredients with a very high fat content is used on everything. The traditional arctic food ration of Pemmican has a very high fat content, and the regard for this non-tasting high caloric foodstuff increases with the length of the journey - but even Pemmican needs to be accompanied by some other kind of food to relieve from the dietary boredom that is the complaint of so many expeditions.

Besides it should not be forgotten, that the caloric value of fat is twice that of protein and carbohydrates and thus provides the highest caloric value for a given weight.

Food composition and especially enhancement of physical performance by dietary means has had a high research priority (6). From the Danish experiences some of the debates on the optimal caloric composition of food seem to more to reflect the public debate on the influence of diet on general health than the basic needs for getting the soldier sufficient nourishment. For patrols operating for prolonged periods in extreme cold the caloric demand is very high. For a patrol of months duration food must be adequate if the soldier shall meet the demands. Dog sledging is hard work. When the environmental temperature drops below -40° C the experience is that food requirements changes. At lower temperatures the caloric intake is high, corresponding to the hard work and is around 7.000 Cals per day. Weight determinations before and after a sledge journey show that most individuals keep their weight constant.

But when it gets colder only fat can meet the demands, and food intake rises toward 10.000 Cals per day. As a patrol man said: "at normal temperatures (i.e. around -30 °C) we are hungry, and eat accordingly - below 40 ° we guzzle our food. I can eat butter directly out of the tin. We eat everything with a lot of sugar".

The same experiences are known from many of the earlier Arctic expeditions, where one had to live on hunting. Protein might even be abundant, but the lack of fat was the determining factor. On the 2.Thule expedition one of the members even committed suicide and in his last letter to his family gave the reason that he could not live on only on rabbit meat -they were only four days from the end of their journey.

The renowned Arctic Explorer Wilhjalmur Stefansson(3) wrote a whole book on the role of fat (pemmican) in the Arctic food. Eskimos regard the traditional fatty food not only as a delicatessen, but as a basic requirement.

The composition of the Danish Pemmican (LØVE-PEMMICAN) is given in Annex A.

Body functions

Regular body functions are of importance for anybody in an extreme climate. Constipation is very often a problem at the beginning of any special mission it might be favoured by dehydration and change in diet. Very often this is difficult to accomplish, especially the first days on a mission. The food should be composed accordingly with an amble content of fibres or a high content of fat and in the training the issue should be rised as an important problem.

BASE ACTIVITIES

The SIRIUS sledge-patrol has its base at 74° N. To the unprepared visitor the base does not live up to the expectations for an isolated outpost hundreds of miles from any other human habitation. The base has all modern facilities. Satellite TVs etc. The rationale is again, that living even in the high Arctic does not mean to live in a primitive way. On base life is "normal". The reason is the same as seen at military airbases. On base everything is as normal as possible. The military duties in the air, or out in the Greenland wilderness should be

in a contrast to routines at base. To live in a primitive environment does not increase efficiency - it only makes life more difficult. All efforts should be concentrated on the real objective, which is the patrolling.

The human relationships at base adheres to the principle, that everybody takes his share in the daily work. This means that although some jobs are dealt out to those with the appropriate training most jobs are performed on a rotational basis. Everybody - even visitors have to take their share in doing the dishing, cleaning and other trivial tasks. This is regarded as very essential to avoid a semi- social stratification. The commander participates on equal terms with his men

TAYLOR ( ) dealt in detail with the psychological problems of smaller isolated groups and the psychological stresses that frequently arose. His aim was to find selection criteria for selecting people for duty in isolated areas. But one of the main problems were associated with the boredom, if the group settled down to daily routines. Even in the best selected groups problems may arise. One of the remedies is to let everybody do his share. If the total work load is low, any workload how small it is may be a burden, and the cause for discussion. It should be a principle, that every work - and especially the mean routine tasks should be shared equally. If a social stratification might occur even within a little group, and this might eventually split the group. With soldiers on a specific mission these problems unless less pronounced, but the leader should always bear his responsibilities for the whole group in mind. He should be the first man to show that success depends on the work of every single member of the group. Cohesion within the group is a must, one of the non visible enemies is boredom. He might benefit from the old Danish saying: Idleness is the root of all evil.

From the Antarctic studies (TAYLOR, RIVOLIER et al.) there are reports on lack of group cohesion and other parameters, which influence the daily life and functions of personnel. These studies may have their relevance on isolated Arctic or Antarctic scientific stations, where the scientific tasks may result in different selections criteria for the group. The scientists are chosen because of their scientific qualifications, and it may be difficult to match these with the groups necessary for supporting the scientific studies. It has been argued, that scientific bases for instance in the Arctic may be a useful model for the manning of space stations. As I do not find similar problems in the small military community, I attribute the better social and psychological performance of the military groups to the uniformity of the group, and especially to the specific training of the group, a training which have many similarities to that of ie astronauts. One important factor for conserving group cohesion is that all tasks, even and perhaps especially the most humble tasks are equally shared by everybody.

During the sledge season (September to December and February to July) only a radio team (one of the sledge teams) is at the base. They keep the daily radio contact with the sledge teams. They are also the only contact with the outer world. At a fixed hour they will broadcast to the teams a survey of the overall weather situation, special news from Denmark and the world. They may have personal messages to individual members. These will often be open to everybody although crypto may be used. But everybody accepts, that news are common news and accepts that their colleagues in other teams are part of the same family and thus shares joys and sorrows. Doctoring is also accomplished from the base. In emergencies the base coordinates eventual search and rescue missions as well as other operation al orders like change in routes and missions etc.

SELECTION CRITERIA

The SIRIUS Sledge Patrol consist of volunteers. Application criteria are: normal health, full eyesight, normal colour vision, single - officers and NCOs. If these requirements are met there are no specific physical criteria - they will be trained physically during their service. Psychological screening was introduced 15 years ago. In the beginning the psychological screening did not contribute much to the selection. This was due to a lack of background knowledge. The criteria for selection for SIRIUS did not follow the criteria normally valued high in the military establishment. High scores in leadership abilities for instance showed to be a negative quality. Good co-operative abilities when working in a group is more essential. Stamina and self-confidence is positive as long as it does not lead to the domination of others.

As more applicants are accepted than actually needed the last selection is made by peer judgement after the initial training period of 6 months. The result of this last screening may not be according to the expectations gained by the initial screening, but within the small group itself small not detectable but very important aspects of personality are uncovered. This peer selection is done on the basis of each individual writing the names of whom he would like mostly to work with and whom he finds he would like the least. The outcome of this final "peer selection" gives nearly each year a very clear selection criteria. The same procedure is used in the patrol, where the "old hand" and the newcomers have to form next years teams. It is very seldom that a solution has to be pressed through.

PREDEPLOYMENT TRAINING

The aim of predeployment training is naturally to train the coming member of the SIRIUS Patrol in all the different aspects of the service that can be done in Denmark before he arrives in Greenland. This is training in his weapons, demolition, radio equipment and its use, boating, skiing and medicine. The medical training corresponds to that given to a shipmaster. He is trained in medical communication in order to enable him to act as the physicians eyes, ears and hands (Radiomedical procedures). He should be able to carry out simple life saving intervention, perform simple emergency operations (minor surgery) like suturing, removal of foreign bodies, plastering of broken limbs etc. The aim of the medical training is to give him confidence that he and his colleagues in an emergency can carry out these procedures and is part of that training in self-confidence and self-reliability which is regarded as essential.

During his more formal training he becomes acquainted with those in Denmark he might contact in emergencies. It is regarded as very essential that he has a good knowledge of those, who in an emergency will take over and direct him. This is regarded as one of the foundations of the safety organisation that it is based upon a personal and intimate knowledge of the persons involved. This consideration goes both ways.

CLOTHING AND PERSONAL EQUIPMENT

In any harsh climates efficiency and profound knowledge is essential to success. The clothing should ensure that the body temperature remains high and normal for the given activity, but body temperature is only one side to cold protection. Optimal functioning is even more important. Optimal functioning is dependant upon the persons ability to maintain high local temperatures in hands and feet ( ). Even in the high Arctic animals maintain very high peripheral temperatures in the muscles of the extremities. A sledge dog sleeping at – 40 °C will have a temperature between the footpads of about + 35 °C. The reason is obvious. Optimal function is temperature dependant. To catch the prey or evade the predator demands optimal physiological functioning. Man fells as good as his feet does is an old saying of people in cold climates. When cold, when threatened by central cooling (hypothermia), the function hands and feet are sold out to preserve life as long as possible. But local cold injury and frostbite is only minutes away in a blizzard at low temperatures. One of the most important lessons for man operating in extreme cold is to know the danger signs of impending local cold injury. Numbness due to cold occurs at a local tissue temperature of 6-7 °C. From that local temperature and lower there is no sensation left. He should know, that the last he may feel of his feet- is that he feels nothing. I have treated serious cases of frostbite, where the patient did not know anything of his condition before he came home and took of boots and socks.

In cold the clothing system should offer correct protection. As stated earlier, the concept is, that man must be able to live in the Arctic as part of it. His natural protection lies within the clothing system. In the later years there has been many new clothing materials. This development has been spurred by the affluent market within the civilian (sporting activities) sector. Much of this has also found its way into military clothing. Some materials are good and even better than the older ones. But any new material or item has to be thoroughly tested before introduction into the service. It seems astounding, but is a fact, that the clothing system used in the cold Arctic winter does in principle not differ much from that used by soldiers operating in Denmark. When working heavily even at very low temperatures, the insulating demand is very diminished. But to the clothing additional protection must be available in order to cover the insulating needs at times where the physical activity is low. The thermal demand on a clothing for the extreme cold is more dependant upon its

ability to change the overall insulation (by ventilating) than the absolute thermal insulation. Water in the clothing, due to sweating and melting snow and ice is the constant danger, as the water creates "cold bridges" between body and environment, and as water displaces the insulating airlayer, that is the basis of all thermal insulation. The clothing system adopted for use in extreme cold has changed very little during the last century. Eskimo clothing although extremely efficient is not acceptable for use as it needs constant repair, and as it will be difficult to obtain in the needed quantities. An arctic explorer from the beginning of the century would marvel over the modern zipper, but the rest would as well in design as in materials be familiar to him. The system is that of the "layer principle", where increased protection against weather and cold is obtained by adding new layers to the system.

The clothing system used for extreme cold consist of an inner "hygienic layer". As there is no way of washing clothes to any sufficient extent for 3-4 months it is essential to teach the modern youth, that many of the rules of basic hygiene he has observed in his normal life has to be disregarded and that this does not to any larger degree create a health hazard. He himself will rapidly observe, that the senses and especially the sense of smell adapts very quickly.

Over the hygienic inner layer the insulating layers are added. These may change according to the thermal load, where it should not be forgotten, that even at very low environmental temperatures, heavy work produces so much heat, that the demands on insulation are very diminished 8). To this decreasing demand, the energy cost of wearing a heavy Arctic clothing has to be added. Modern man-made materials are changing the principles of clothing. But old fashioned wool and cotton are still in very high regard. The modern thermopile fibres have an advantage in being lighter for a given in sulation, but their role in water accumulation and water transmission has yet to be evaluated. One disadvantage is that most of these materials are inflammable and thus when used in the small space of the tent may present the most dreaded hazard of the Arctic - fire.

CONCLUSIONS

The Danish Armed Forces have for more than 25 years maintained small isolated military groups in the Arctic. It is the Danish experience, that in maintaining these groups on a high level of efficiency the following principles weights very heavy:

- the members of the group should be selected not on basis of their individual cognitive skills, but more for their ability to work subordinate to the common demand of their peers.
- in the small isolated group the need for good traditional military leadership is of less importance and little relevance, as the group exists on the basis of every members ability to work subordinate to the common goal.
- training together for all the common necessary skills is important to avoid "social stratification within the small group.
- in the very small group everybody is important, and within the group there will be a very sensitive psychological mechanism, which tends to eliminate the risk of anyone "dropping out".
- premission training in all necessary job skills is necessary. In a harsh environment you have to "be prepared" for all conceivable emergencies. All experiences should be analysed and find their way into the future training . This is especially important in groups that only have a "life-span" of only two years, as that means that the collective memory is very short.
- the group should always have a consultant at base 7 home, that personally has earlier experience in the functions of the group, and who "at home" can follow the group. He should know all the individuals. He will eventually be the consultant in emergencies.
- before mission all parts of the equipment (clothing, weapons, machinery etc.) should be well known to everybody. In a harsh environment, there will be very little time for mistakes.

References

Marriott, B.M. Food Components to Enhance Performance, Committtee on Military Nutrition Research, National Academy Press, Washington D.C. 1994.

Military Nutrition, AC 243 (Panel 8/RSG.8)/D/9 (unclassified/unlimited), NATO 1989.

Stefansson, Wilhjalmur, Pemmican, 19XX.

Taylor, A.J.W. Antarctic Psychology, DSIR Bulletin no. 244, Science Information Publishing Press, Wellington, New Zealand 1987.

Handbook on Military Clothing, AC243 (Panel 8/RSG.7) (unclassified/unlimited), NATO 1988.

Rivolier, J. Facteurs humains et situations extreêmes, Masson, Paris 1992.

Vallerand, A.L. Biochemical Enhancement of Cold Tolerance in: AGARD Conference Proceedings no. 540, NATO 1993.

Vanggaard, L. Physiological Reactions top Wet-Cold, Aviat. Space, and Env. Med. 46(1):33-36, 1975.

Mikkelsen, A, SAiriuspatruljens proviant, Rapport L7477, 1992.

Nutritional Guidance for Military Field Operations in Temperate and Extreme Environments, USARIEM Technical Note 93-8, 1993.

Rivolier, J.R. Goldsmith, D.J. Lugg & A.J.W Taylor. Man in the Antarctic, Taylor & Francis London 1988.

ANNEX A

LØVEN PEMMIKAN

Contents of Pemmican used by the Danish Dog-sledge Patrol in Northeastern Greenland.

12 % soyaprotein
10 % milkprotein
30 % pea flour
3+ % vegetable oil

2-3 % vitamins
mikrominerals
antioxydant
15 % water

Energy distribution: 28 % protein
55 % fat
17% carbohydrates

Energy content per 100 g: 2266 KJ = 536 Kal.

The same Pemmican is used by dogs and man. The transportation costs are so high, that it would not be logistically relevant to have two different Pemmicans.

In extreme cold man requires 7.000 to 10.000 Kal per day.

The sledge dog requires and gets beween 3.500 to 4.500 Kal per day.